Signals and Circuits

ENGR 35500

Power Energy Source

Chapter 1 Circuit Terminology: 1-3 (Circuit Representation) 1-5 (Voltage and Power)， 1-6 （Circuit elements);
Ulaby, Fawwaz T., and Maharbiz, Michael M., *Circuits*, 2nd Edition, National Technology and Science Press, 2013.

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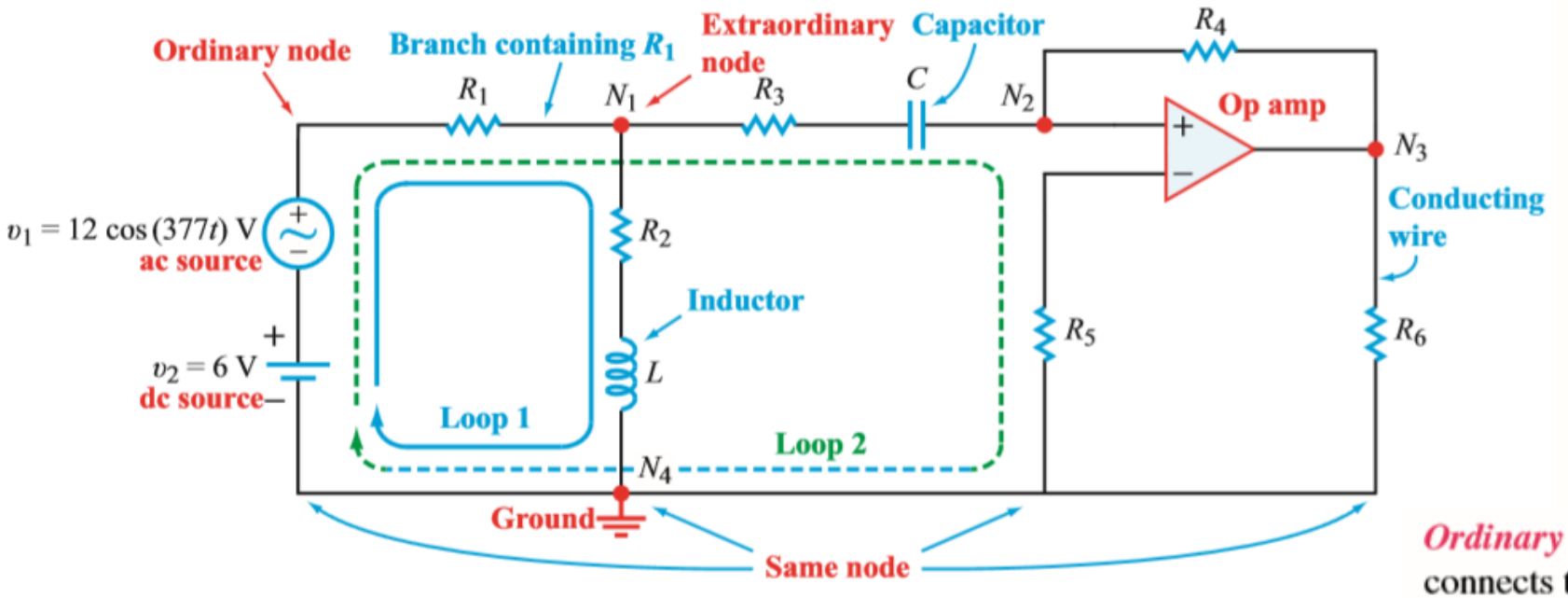
Power of Resistor

$$p = vi = v \cdot \frac{v}{r} \quad = \frac{v^2}{r}$$

*This equation is always correct if you measure the voltage, power and resistance simultaneously.

Circuit Architecture



Ordinary node: An electrical connection point that connects to only two elements.

Extraordinary node: An electrical connection point that connects to three or more elements.

Branch: Trace between two consecutive nodes with only one element between them.

Path: Continuous sequence of branches with no node encountered more than once.

Extraordinary path: Path between two adjacent extraordinary nodes.

Loop: Closed path with the same start and end node.

Independent loop: Loop containing one or more branches not contained in any other independent loop.

Mesh: Loop that encloses no other loops.

In-series: Elements that share the same current.

In-parallel: Elements that share the same voltage.

Independent loop vs Mesh?

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Circuit Architecture

Practice

(a) Identify and label all distinct nodes.

(b) Which of those nodes are extraordinary nodes?

(c) Identify all combinations of 2 or more circuit elements that are connected in series.

(d) Identify pairs of circuit elements that are connected in parallel.

(e) Identify the mesh loops.

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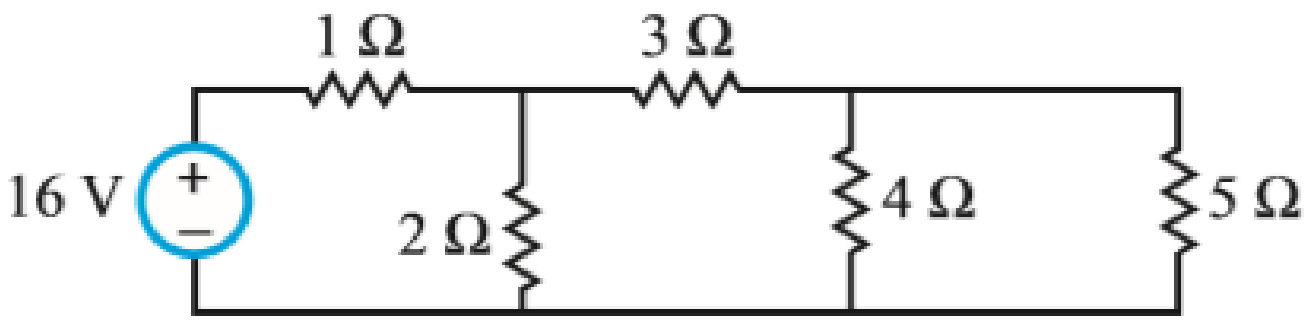

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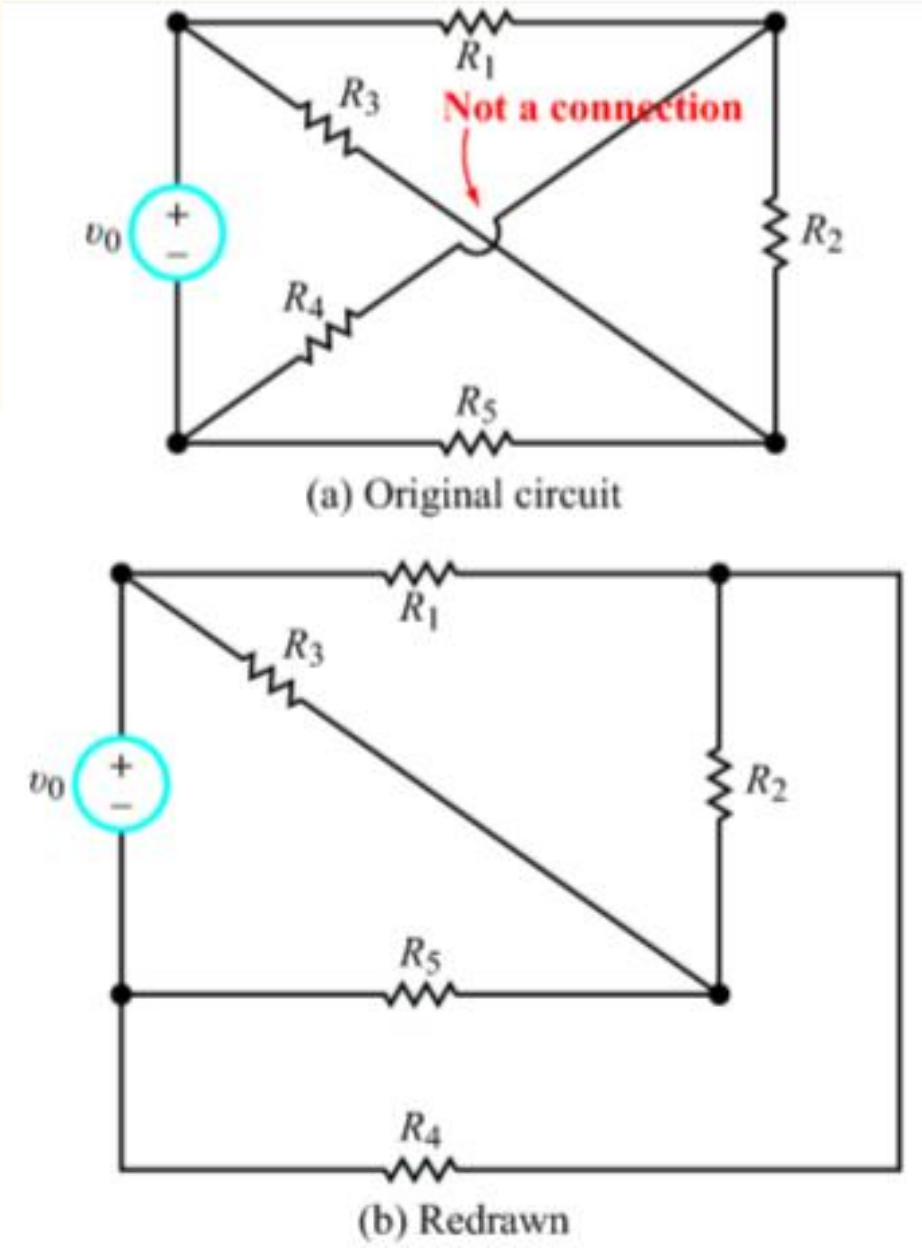
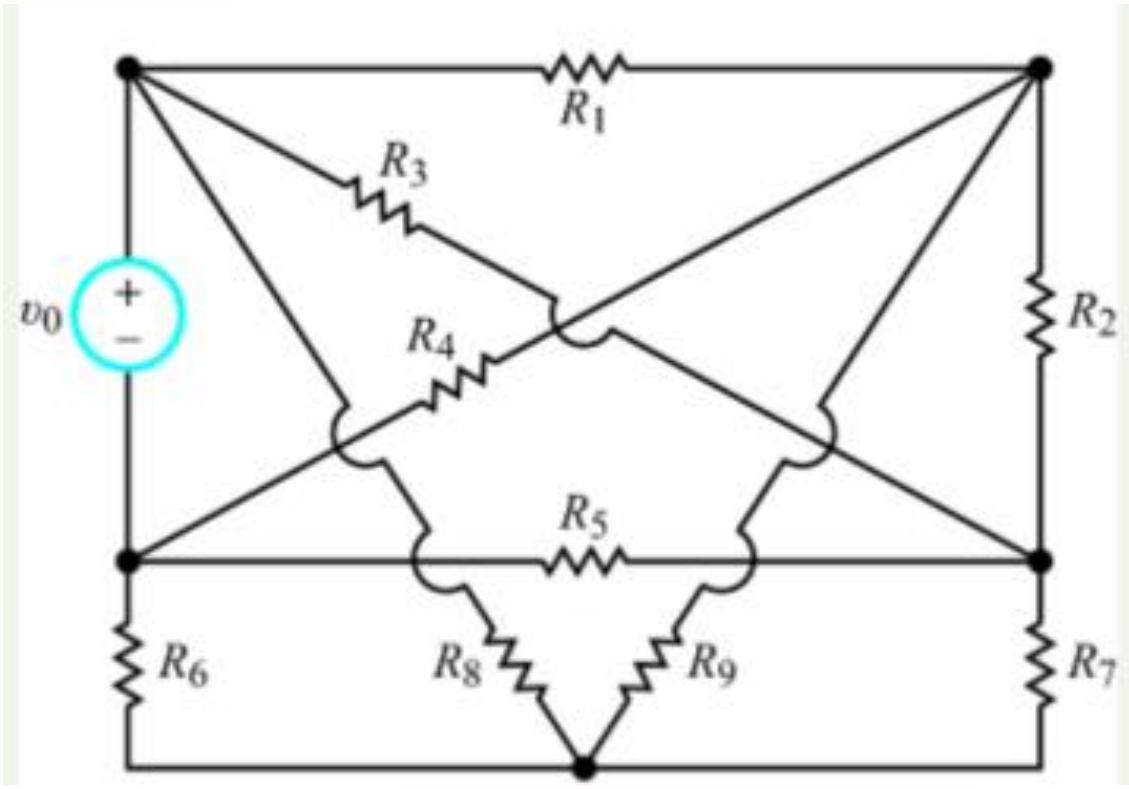
Planar Circuit



Planar circuit



Nonplanar circuit

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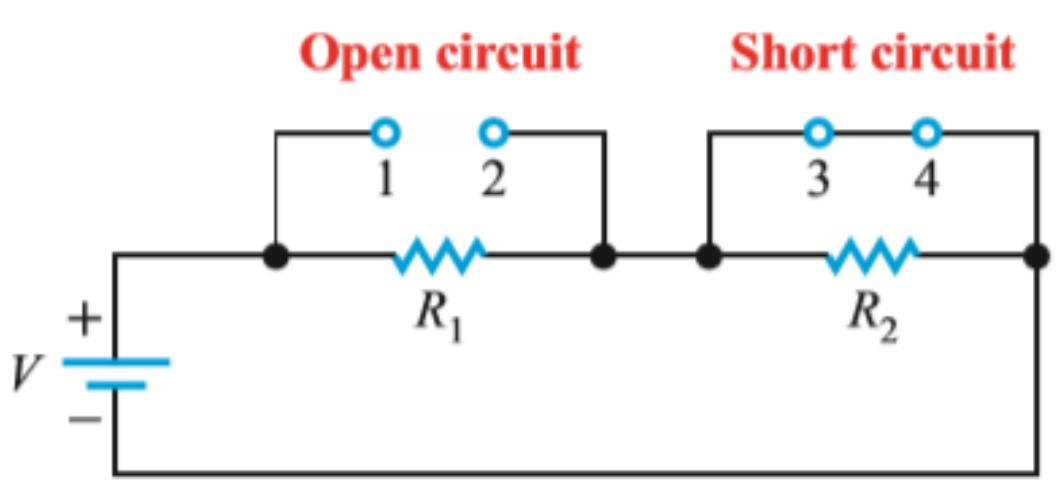
Open and short circuits

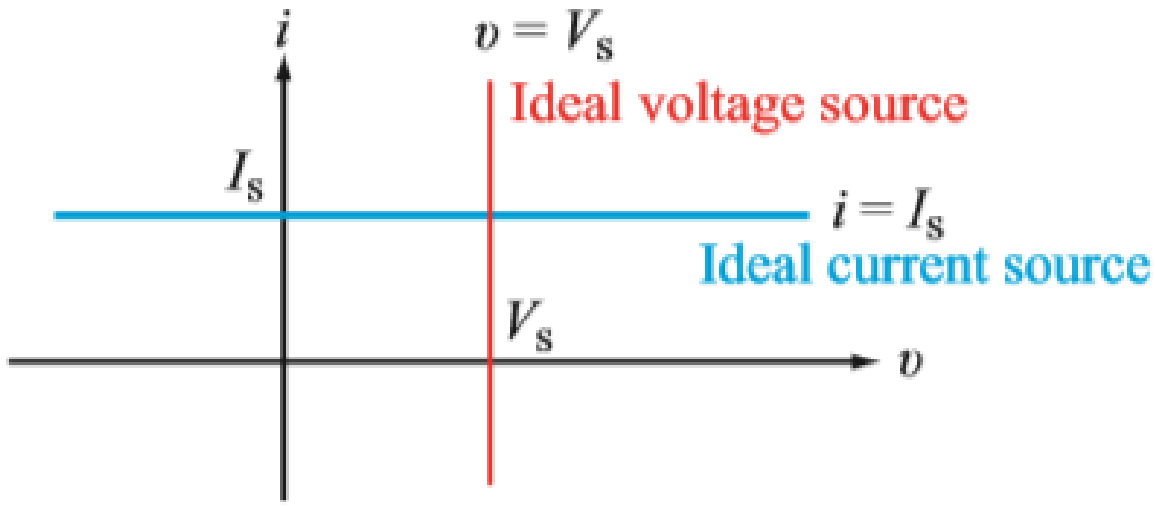


An **open circuit** refers to the condition of path discontinuity (infinite resistance) between two points. No Current can flow through an open circuit, regardless of the voltage across it.

A **short circuit** constitutes the condition of complete path continuity (with zero electrical resistance) between two points.

Power sources

Independent source

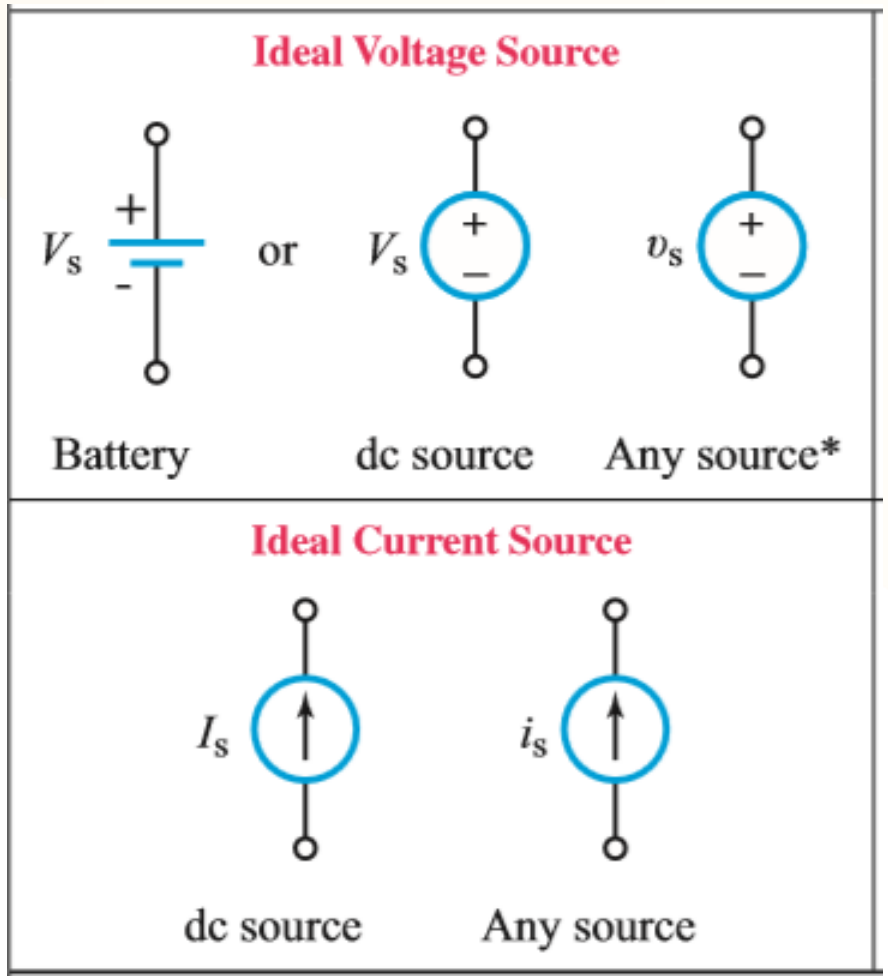


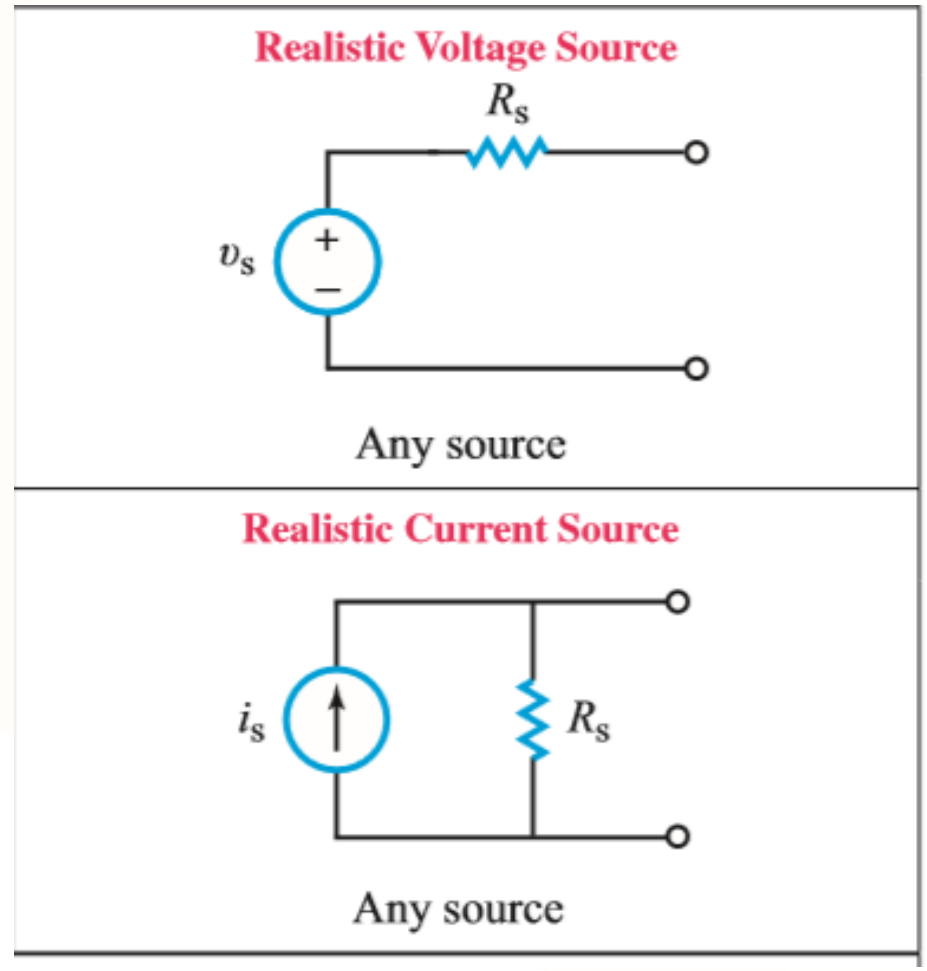
An ***ideal, independent voltage source*** provides a specified ***voltage*** across its terminals, regardless of the type of load or circuit connected to it.

An ***ideal, independent current source*** provides a specified *current* flowing the circuit, regardless of the type of load or circuit connected to it (cannot do so if connected to an open circuit).

Power sources

Independent source





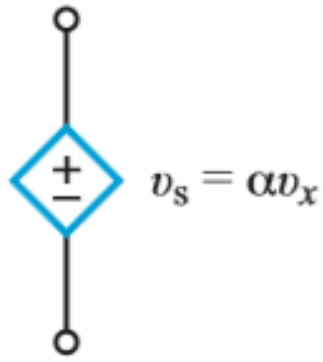
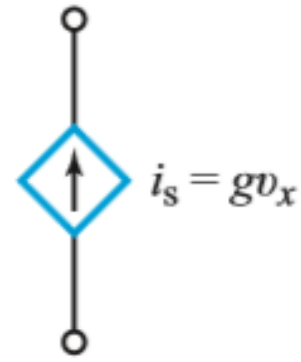
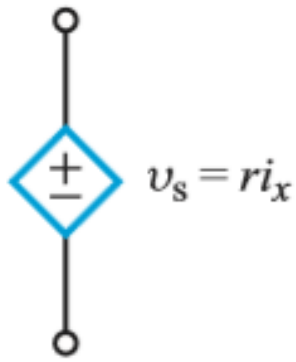
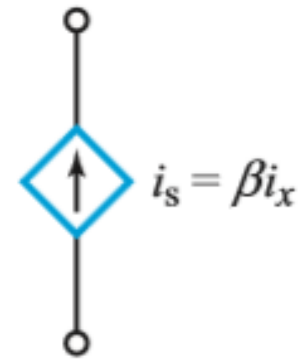
Rs ?

Power sources

Dependent source

The source depends on the relationship between the characteristics of the source and the current or voltage of other devices.

Dependent Sources

Voltage-Controlled Voltage Source (VCVS)	Voltage-Controlled Current Source (VCCS)
	
Current-Controlled Voltage Source (CCVS)	**Current-Controlled Current Source (CCCS)**
	

Note: α, g, r, and β are constants; v_x and i_x are a specific voltage and a specific current elsewhere in the circuit.

*Lowercase v and i represent voltage and current sources that may or may not be time varying, whereas uppercase V and I denote dc sources.

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Power sources

Dependent source

Dependent Sources

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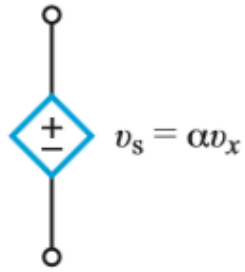	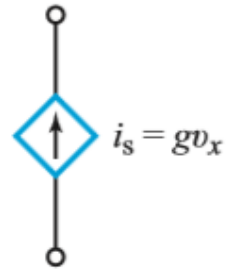
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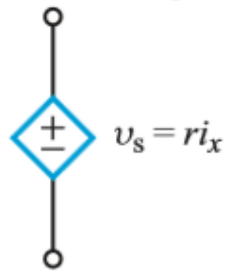	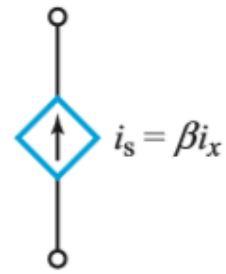

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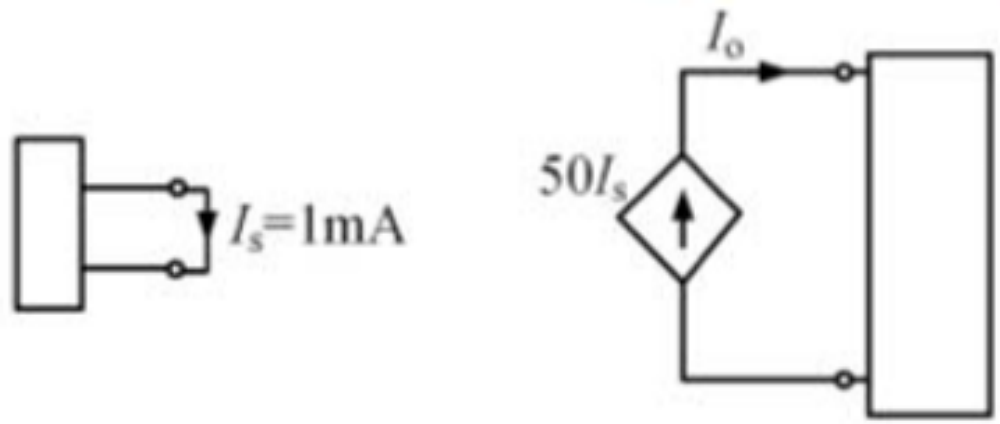

Power sources

Dependent source

Determine ***V***, the voltage of the dependent voltage source in the circuit.